WORK IT OUT

A maths workbook — concepts, worked examples, graded practice and number puzzles

Do the Learn First pages before the practice. Do the practice before the puzzles. Full solutions are at the back — but they only help you after you have tried.

Part	What it is	How to use it	Time
1	Learn First	Read and annotate. Copy every worked example by hand.	25 min
2	Worked Examples	Cover the solution. Try. Then compare line by line.	20 min
3	Guided Practice	Steps are given; you fill the gaps.	15 min
4	Practice Set A · Fluency	Straight application. Aim for speed and accuracy.	20 min
5	Practice Set B · Reasoning	Multi-step. Show every line.	25 min
6	Practice Set C · Challenge	Stretch problems. One may beat you — that is fine.	25 min
7	The Crossnumber	Answers are numbers. Wrong maths will not fit.	20 min
8	Number Search & Magic Square	Solo or pairs.	15 min
9	Spot the Mistake	Audit a worked solution. Find the planted error.	15 min
10	Quick-Fire Round	Matching, True/False, Two Truths and a Lie.	15 min
11	The Escape Challenge	Teams of 4.	25 min

Part 1 · Learn First

Every athlete on a curved running track, every farmer fencing a field, and every tiler covering a floor is really asking one of two questions: how far around, or how much surface. This chapter answers both — with formulas you can prove, not just memorise.

Perimeter — the distance around

Imagine an insect walking around the border of a shape, never turning back, until it returns to its start. The total distance it walks is the **perimeter**.

The relay-race puzzle. At the start of a 4×100 m relay, runners in outer lanes start ahead of those in inner lanes — this head start is called the **stagger**. It exists because outer lanes trace larger semicircles on the curved part of the track, so they must cover extra distance that has to be compensated for.

Why the ratio idea matters. If you double the side of a square, its perimeter doubles too — the ratio perimeter : side is always $4:1$. For an equilateral triangle it is always $3:1$. This constant-ratio idea is exactly what leads to π for the circle.

Shape	Perimeter formula	Why
Square (side a)	$4a$	four equal sides
Equilateral triangle (side a)	$3a$	three equal sides
Rectangle (length a, width b)	$2(a+b)$	two pairs of equal sides
Circle (radius r)	$2\pi r$	circumference = $\pi \times$ diameter

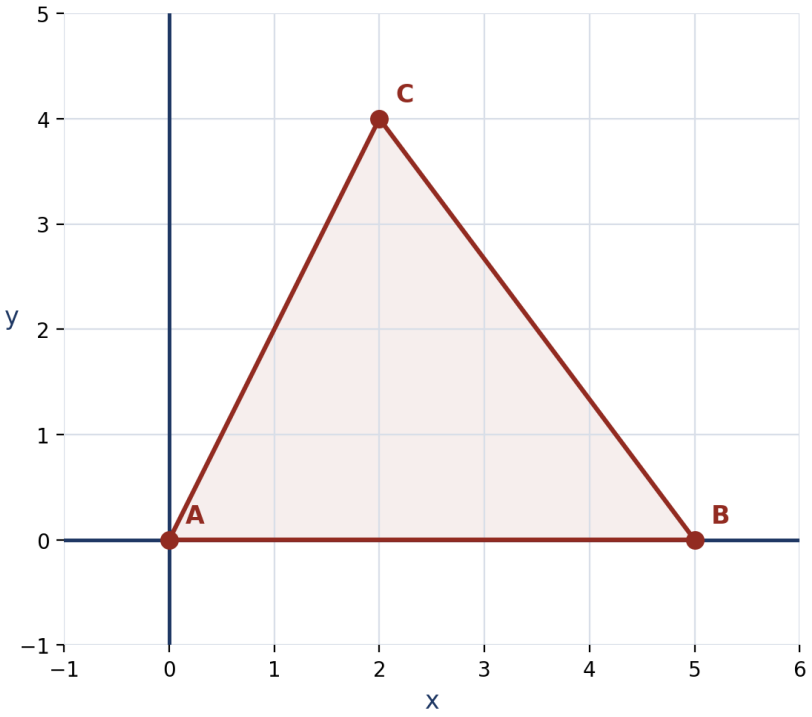


Fig. 6.1 — Triangle ABC used for Heron's formula

Rule to remember

- The ratio of a shape's perimeter to a fixed length (side, or diameter) stays the same as the shape is scaled up or down — this is what makes constants like the $4:1$ square ratio, or π for circles, possible.
- Circumference of a circle: $C = 2\pi r = \pi d$, where $d = 2r$ is the diameter.

The C/D ratio and π

The ratio of a circle's circumference (C) to its diameter (D) never changes, no matter how big or small the circle. Ancient mathematicians spent centuries refining this constant, which we call **π** (pi).

Important: π is irrational — it cannot be written exactly as $\frac{p}{q}$. So $\pi \approx \frac{22}{7}$ and $\pi \approx 3.14$, but $\pi \neq \frac{22}{7}$. A better approximation is $\frac{355}{113}$.

Arc length. If an arc AB subtends an angle $\theta°$ at the centre of a circle of radius r, its length is $2\pi r \times \frac{\theta°}{360°}$. A semicircular arc ($\theta = 180°$) has length πr; a quarter-circle arc has length $\frac{\pi r}{2}$.

Mathematician / era	Approximation for π
Mesopotamia (c. 1900 BCE)	$3\frac{1}{8} = 3.125$
Archimedes (250 BCE)	between $3\frac{10}{71}$ and $3\frac{1}{7}$
Zu Chongzhi (480 CE)	$\frac{22}{7} \approx 3.1428$ and $\frac{355}{113} \approx 3.1415929$
Āryabhaṭa (499 CE)	3.1416
Mādhava of Sangamagrāma	infinite series — 11 decimal places

Rule to remember

- Arc length ¿ $2\pi r \times \frac{\theta°}{360°}$
- $\pi \approx \frac{22}{7} \approx 3.14$, but π is irrational — never exactly equal to any fraction.

The 400 m athletics track

A track has two straight sections of 84.39 m each, and two semicircular ends of radius 36.5 m. An athlete runs 0.3 m from the inner border.

Straight sections: $2 \times 84.39 = 168.78$ m.

Running radius: $36.5 + 0.3 = 36.8$ m. The two semicircles together make one

full circle of this radius.

Circle circumference: $2 \times 3.1416 \times 36.8 = 231.22$ m.

Total distance: $168.78 + 231.22 = 400$ m — confirming the "400 m" track name.

Why staggers exist: a runner one lane out has a larger semicircle radius, so without a stagger she would run further than the inside runner for the same 400 m marked distance.

Area of a triangle — Heron's formula

You already know **area** ¿ $\frac{1}{2}$ × **base** × **height**. Heron of Alexandria found a formula that uses only the three side lengths — no height needed at all.

For a triangle with sides a, b, c, first find the **semi-perimeter**:

$$s=\frac{1}{2}(a+b+c)$$

Then the area is:

$$Area=\sqrt{s(s-a)(s-b)(s-c)}$$

Check — equilateral triangle, side a: $s=\frac{3a}{2}$, and Heron's formula gives $Area=\frac{\sqrt{3}}{4}a^2$ — matching the "half base × height" result using $h=\frac{\sqrt{3}}{2}a$ from the Baudhāyana–Pythagoras theorem.

Triangle	Semi-perimeter s	Area by Heron's formula
3, 4, 5	$s=6$	$\sqrt{6\times3\times2\times1}=6$ sq. units
5, 5, 6 (isosceles)	$s=8$	$\sqrt{8\times3\times3\times2}=12$ sq. units
Equilateral, side a	$s=\frac{3a}{2}$	$\frac{\sqrt{3}}{4}a^2$ sq. units

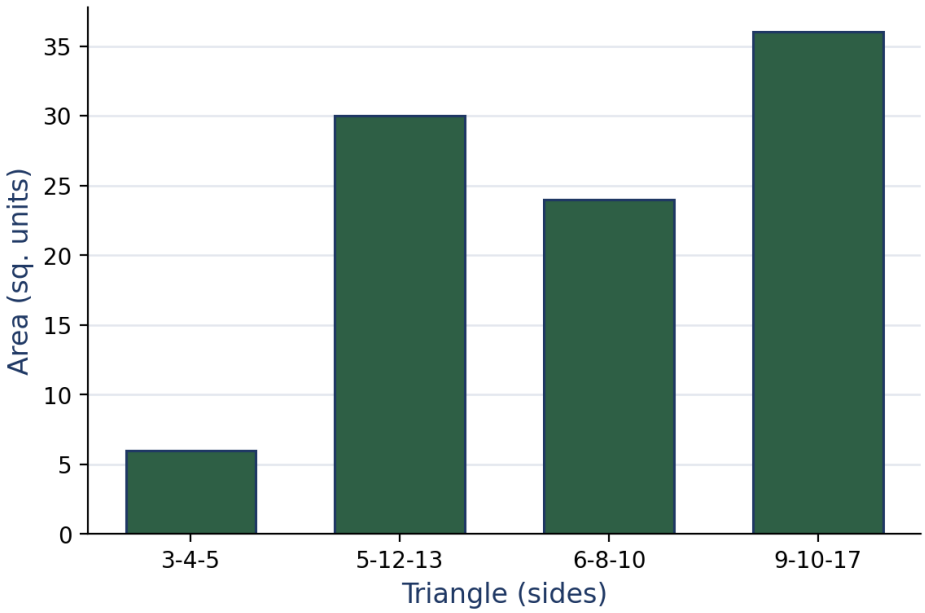


Fig. 6.2 — comparing areas of four right triangles by Heron's formula

Rule to remember

- $s = \frac{1}{2}(a+b+c)$, then Area ¿ $\sqrt{s(s-a)(s-b)(s-c)}$.
- Isosceles triangle, equal sides a, base $2b$: Area ¿ $b\sqrt{a^2-b^2}$.

□ Sides 3, 4, 5 units — Heron's formula vs. base × height

Heron's formula: $s = \frac{1}{2}(3+4+5) = 6$.

Area ¿ $\sqrt{6(6-3)(6-4)(6-5)} = \sqrt{6 \times 3 \times 2 \times 1} = \sqrt{36} = 6$ sq. units.

Cross-check: since $3^2+4^2=5^2$, by the converse of the Baudhāyana–Pythagoras theorem the triangle is right-angled with legs 3 and 4.

Area ¿ $\frac{1}{2}(3 \times 4) = 6$ sq. units — the same answer.

Note: whenever the base and height are hard to find directly (no right angle visible), Heron's formula still works from the three sides alone.

Brahmagupta's formula — area of a cyclic quadrilateral

A **cyclic quadrilateral** is a 4-sided figure whose vertices all lie on one circle. Brahmagupta (628 CE) found a Heron-like formula for its area.

For a cyclic quadrilateral with sides a, b, c, d and semi-perimeter $s=\frac{1}{2}(a+b+c+d)$:

$$Area=\sqrt{(s-a)(s-b)(s-c)(s-d)}$$

Special case — rectangle (sides a, b; all rectangles are cyclic): $s=a+b$, so Area ¿$\sqrt{a\,b\cdot a\,b}=a\,b$ — exactly the familiar length $\times$ width formula.

Connection to Heron's formula: if one side shrinks to $d=0$, the quadrilateral collapses into a triangle, and Brahmagupta's formula reduces exactly to Heron's formula. Heron's formula is a special case of Brahmagupta's!

Shape	Standard area formula
Rectangle (length a, width b)	$a\,b$
Square (side a)	a^2
Parallelogram (base b, height h)	$b\,h$
Triangle (base b, height h)	$\frac{1}{2}b\,h$
Trapezium (parallel sides a, b; height h)	$\frac{1}{2}(a+b)h$
Rhombus (diagonals d_1, d_2)	$\frac{1}{2}d_1\,d_2$
Circle (radius r)	$\pi\,r^2$

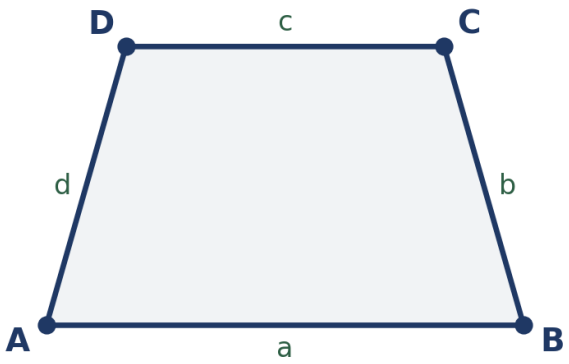


Fig. 6.3 — a cyclic quadrilateral ABCD with sides a, b, c, d

Formulas to remember

- $s=\frac{1}{2}(a+b+c+d)$, then Area ¿$\sqrt{(s-a)(s-b)(s-c)(s-d)}$ (cyclic quadrilaterals only).
- Circle area: $A=\pi r^2$.

Part 2 · Worked Examples

Cover the right-hand column with a sheet of paper. Try the problem yourself first. Then uncover it one line at a time and check where your reasoning parted from the model.

Example 1 — Find the area of a triangle with sides 13 cm, 14 cm, 15 cm using Heron's formula

Step 1. Semi-perimeter $s=\frac{1}{2}(13+14+15)=\frac{42}{2}=21$ cm.

Step 2. $s-a=21-13=8$, $s-b=21-14=7$, $s-c=21-15=6$.

Step 3. Area $¿\sqrt{21\times8\times7\times6}=\sqrt{7056}=84$ sq. cm.

Answer: 84 sq. cm.

> **Why this works**
>
> Heron's formula needs no height and no right angle — it works for every triangle, given only the three sides.

Example 2 — A running track has two straight sides of 90 m each and two semicircular ends of radius 28 m. Find the perimeter (use $\pi=\frac{22}{7}$).

Step 1. The two semicircular ends together make one full circle of radius 28 m.

Step 2. Circumference of that circle $¿2\pi r=2\times\frac{22}{7}\times28=176$ m.

Step 3. Total perimeter ¿ two straight sides +¿ circle
$¿2(90)+176=180+176=356$ m.

Answer: 356 m.

> **Why this works**
>
> This is exactly the athletics-track idea from the chapter opener — two straights plus one full circle formed by the two curved ends.

Example 3 — Verify Brahmagupta's formula for a rectangle of sides 6 cm and 8 cm, and compare with the usual formula

Step 1. A rectangle is cyclic, so Brahmagupta's formula applies with $a=6, b=8, c=6, d=8$.

Step 2. $s=\frac{1}{2}(6+8+6+8)=14$.

Step 3. Area $¿\sqrt{(14-6)(14-8)(14-6)(14-8)}=\sqrt{8\times6\times8\times6}=48$ sq. cm.

Step 4. Compare: usual formula gives $6 \times 8 = 48$ sq. cm.

Answer: Both give 48 sq. cm — Brahmagupta's formula checks out.

> **Why this works**
>
> A rectangle is the simplest cyclic quadrilateral, so it is the natural first case to test any new formula against.

Part 3 · Guided Practice

The method is laid out for you. Fill in the blanks. If you can do these without looking back at Part 2, you are ready for Part 4.

1. Find the area of a triangle with sides 9 cm, 10 cm, 11 cm using Heron's formula.

Semi-perimeter: $s=\frac{9+10+11}{2}=$ ¿ _____ cm.

$s-a=$ ¿ _____, $s-b=$ ¿ _____, $s-c=$ ¿ _____.

Area ¿ $\sqrt{15 \times$ ¿ $\times$ ¿ $\times$ ¿ $}=\sqrt{$ ¿ ¿ $}$ sq. cm.

---

2. A circular park has radius 21 m. Find its circumference and area (use $\pi=\frac{22}{7}$).

Circumference ¿ $2\pi r=2\times\frac{22}{7}\times$ ¿ $=$ ¿ _____ m.

Area ¿ $\pi r^2=\frac{22}{7}\times$ ¿ $\times$ ¿ $=$ ¿ _____ sq. m.

---

3. An isosceles triangle has equal sides 13 cm and base 10 cm. Find its area using $b\sqrt{a^2-b^2}$.

Here $a=13$, and base ¿ $2b$ so $b=$ ¿ _____.

Area ¿ $b\sqrt{a^2-b^2}=$ ¿ $\sqrt{$ ¿ ¿ $^2-$ ¿ ^{2} ¿ $=$ ¿ $\sqrt{$ ¿ ¿ ¿ $}$.

Area ¿ _____ sq. cm.

---

4. Find the length of an arc subtending 60° at the centre of a circle of radius 21 cm (use $\pi=\frac{22}{7}$).

Arc length ¿ $2\pi r\times\frac{\theta}{360}=2\times\frac{22}{7}\times$ ¿ $\times\frac{$ ¿ ¿ $}{360}$ ¿.

Simplify step by step: ¿ $132\times\frac{1}{$ ¿ $=$ ¿ ¿ $}$ _____ cm.

Practice Set A · Fluency

Straight application of the method. Aim to get every one right, then aim to get them right quickly.

#	Question	Your working and answer
1	Find the perimeter of a square of side 15 cm.	
2	Find the perimeter of a rectangle with length 12 cm and breadth 7 cm.	
3	Find the circumference of a circle of radius 14 cm (use $\pi = \frac{22}{7}$).	
4	Find the area of an equilateral triangle of side 6 cm.	
5	Find the area of a triangle with sides 5 cm, 5 cm, 6 cm using Heron's formula.	
6	A rectangular field is 40 m long and 25 m wide. Find its area.	
7	Find the area of a circle of radius 7 cm.	
8	Find the area of a rhombus whose diagonals are 10 cm and 12 cm.	
9	Find the area of a parallelogram with base 9 cm and height 6 cm.	
10	A triangle has sides 7 cm, 24 cm, 25 cm. Find its area using Heron's formula.	

Practice Set B · Reasoning

Two or more steps, or a step you have to choose for yourself. Show every line — marks live in the working.

#	Question	Your working and answer
1	The sides of a triangle are 11 cm, 60 cm, 61 cm. Find its area using Heron's formula.	
2	A park is in the shape of a rectangle 80 m by 60 m. Find the cost of fencing it at ₹20 per metre.	
3	Find the length of an arc subtending 90° at the centre of a circle of radius 14 cm.	
4	The perimeter of an equilateral triangle is 60 cm. Find its area using Heron's formula.	
5	A trapezium has parallel sides 15 cm and 9 cm, and height 8 cm. Find its area.	
6	Verify Brahmagupta's formula for a square of side 5 cm.	
7	Two circles of radius 7 cm each pass through the other's centre. Find the perimeter of the overlapping (vesica) shape formed, ignoring the portion inside both circles.	
8	A triangular park has sides 30 m, 40 m, 50 m. Find the cost of levelling it at ₹5 per sq. m.	

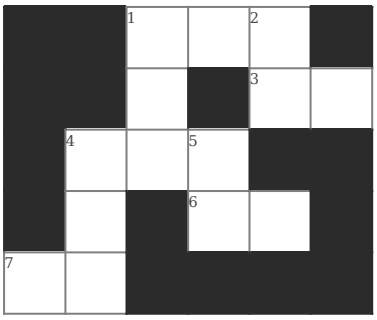
Practice Set C · Challenge

Harder, and deliberately so. If one defeats you, write down exactly where you got stuck. That sentence is worth more than a copied answer.

#	Question	Your working and answer
1	An isosceles triangle has a perimeter of 32 cm and each equal side is 9 cm longer than half the base. Find its area using Heron's formula.	
2	A running track has two straight sides of 100 m each and two semicircular ends of radius 35 m. Find the total distance around the track (use $\pi = \frac{22}{7}$), and compare it to a "400 m" standard track.	
3	Show that Heron's formula reduces to $\frac{\sqrt{3}}{4}a^2$ for an equilateral triangle of side a, starting from $s = \frac{3a}{2}$.	
4	A cyclic quadrilateral has sides 9 cm, 12 cm, 13 cm, and 14 cm. Use Brahmagupta's formula to find its area.	
5	Explain, using the idea of the C/D ratio, why doubling the radius of a circle exactly doubles its circumference but *quadruples* its area.	

Part 7 · The Crossnumber

Every answer is a number. One digit per square. Because answers cross, a wrong calculation simply will not fit — this puzzle marks itself.



ACROSS

1. Circumference (m) of a circle of radius 28 m, π = 22/7 *(3 digits)*

3. Area (sq. cm) of an isosceles triangle, equal sides 13, base 10 *(2 digits)*

4. Area (sq. cm) of a rhombus, diagonals 18 and 12 *(3 digits)*

6. Area (sq. cm) of a rectangle 6 cm by 8 cm *(2 digits)*

7. Area (sq. cm) of a triangle with sides 6, 8, 10 *(2 digits)*

DOWN

1. Area (sq. cm) of a square of side 10 cm *(3 digits)*

2. Perimeter (cm) of a rectangle 21 cm by 12 cm *(2 digits)*

4. Area (sq. cm) of a circle of radius 7 cm, π = 22/7 *(3 digits)*

5. Area (sq. cm) of the 13-14-15 triangle *(2 digits)*

Bonus questions that did not fit the grid — work them out anyway: Area (sq. cm) of a parallelogram, base 8, height 7

Part 8 · Number Search & Magic Square

Work out each answer, then find it hidden in the digit grid — across, down, diagonally or backwards.

1	3	6	4	6	1	7	0	2	4	2	7	2
1	0	2	4	0	1	5	4	8	8	4	2	6
0	3	9	0	7	0	8	8	4	5	5	7	7
3	9	1	7	6	5	8	9	8	6	3	3	0
6	6	9	8	5	2	3	8	2	5	9	6	5
5	2	9	4	3	1	0	7	0	1	0	9	2
5	6	3	7	6	1	5	6	2	5	4	1	8
3	2	9	4	7	5	6	1	0	9	2	0	0
9	3	8	5	6	3	1	6	5	3	2	3	9
1	7	0	7	6	6	0	0	7	4	0	8	1
2	0	5	1	1	8	3	5	1	4	9	2	3
8	1	0	1	2	8	0	1	0	0	3	5	5
8	5	2	9	0	9	5	0	0	8	2	3	1

☐ 176	☐ 154	☐ 108	☐ 100	☐ 132
☐ 84	☐ 24	☐ 60	☐ 48	☐ 56
☐ 66	☐ 21			

Magic Square — every row, column and diagonal adds to the same total.

8	**1**	
3	**5**	
	9	

Magic constant: 15. Fill the empty cells.

Part 9 · Spot the Mistake

Each solution below reaches a wrong answer, and exactly one step is to blame. Find the first wrong step and rewrite it correctly. Marking other people's work is the fastest way to stop making their mistakes.

❓ Spot the Mistake

Finding the area of a triangle with sides 9, 10, 11 by Heron's formula

Step 1. Semi-perimeter $s = 9+10+11 = 30$.

Step 2. $s-a = 21, s-b = 20, s-c = 19$.

Step 3. Area ¿ $\sqrt{30 \times 21 \times 20 \times 19}$.

_____ The first wrong step is Step _____ . What should it say?

_____

❓ Spot the Mistake

Finding the circumference of a circle of radius 10.5 cm using π = 22/7

Step 1. Circumference ¿ πr^2.

Step 2. ¿ $\frac{22}{7} \times 10.5 \times 10.5$.

Step 3. ¿ 346.5 cm.

_____ The first wrong step is Step _____ . What should it say?

_____

❓ Spot the Mistake

Comparing π with $\frac{22}{7}$

Step 1. $\frac{22}{7}$ is used often because it is close to π.

Step 2. Since $\frac{22}{7} \approx 3.14$, we can say $\pi = \frac{22}{7}$ exactly.

Step 3. π is an irrational number, so no fraction equals it exactly.

_____ The first wrong step is Step _____ . What should it say?

_____

Part 10 · Quick-Fire Round

Match each shape to its area formula

Draw a line from each item on the left to its match on the right.

#	Left	Right (shuffled)
1	Square, side a	a^2
2	Rectangle, sides a, b	$\sqrt{s(s-a)(s-b)(s-c)}$
3	Triangle, base b, height h	$\frac{1}{2} d_1 d_2$
4	Circle, radius r	$\frac{1}{2}(a+b)h$
5	Rhombus, diagonals d_1, d_2	$\sqrt{(s-a)(s-b)(s-c)(s-d)}$
6	Trapezium, parallel sides a, b, height h	πr^2
7	Triangle, sides a, b, c	$\frac{1}{2} b h$
8	Cyclic quadrilateral, sides a, b, c, d	$a\,b$

True or False Sprint

Everyone stands. Teacher reads a statement. True → stay standing. False → sit down.

#	Statement	Your call
1	The perimeter of a square with side a is $4\,a$.	☐ True ☐ False
2	The circumference of a circle equals πr^2.	☐ True ☐ False
3	π is a rational number.	☐ True ☐ False
4	$\frac{22}{7}$ is exactly equal to π.	☐ True ☐ False
5	Heron's formula needs the height of the triangle.	☐ True ☐ False
6	The semi-perimeter is half the perimeter.	☐ True ☐ False
7	All rectangles are cyclic quadrilaterals.	☐ True ☐ False
8	Brahmagupta's formula reduces to Heron's formula when one side becomes 0.	☐ True ☐ False
9	The area of a rhombus is $d_1 \times d_2$.	☐ True ☐ False

#	Statement	Your call
10	A quarter-circle arc has length $\frac{\pi r}{2}$.	☐ True ☐ False
11	Doubling the radius of a circle doubles its area.	☐ True ☐ False
12	The stagger in a relay race exists because outer lanes trace larger semicircles.	☐ True ☐ False

Two Truths and a Lie

Two statements are true, one is false. Circle the lie — then correct it.

Set 1

(a) Heron's formula uses only the three sides of a triangle.

(b) Heron's formula requires the triangle to be right-angled.

(c) The semi-perimeter is $s=\frac{1}{2}(a+b+c)$.

The lie is _____ . Corrected: _____

Set 2

(a) $\pi \approx \frac{22}{7}$.

(b) π is irrational.

(c) $\pi = 3.14$ exactly.

The lie is _____ . Corrected: _____

Set 3

(a) The area of a circle is πr^2.

(b) The area of a rectangle equals $a\,b$, where a, b are the sides.

(c) The area of a rhombus is $\frac{1}{2}(d_1+d_2)$.

The lie is _____ . Corrected: _____

Part 11 · The Escape Challenge

Five gates, each a calculation. Each gives you one digit. Collect all five to unlock the exit code.

🔒 GATE 1 — The Heron Gate

Find the area (sq. units) of a triangle with sides 3, 4, 5.

Digit: ☐

🔒 GATE 2 — The Circle Gate

Find the circumference (cm) of a circle of radius 7 cm, using $\pi = \frac{22}{7}$.

Digit: ☐

🔒 GATE 3 — The Rhombus Gate

Find the area (sq. cm) of a rhombus with diagonals 6 cm and 8 cm.

Digit: ☐

🔒 GATE 4 — The Semi-perimeter Gate

A triangle has sides 9, 10, 11. What is its semi-perimeter?

Digit: ☐

🔒 GATE 5 — The Track Gate

A track has two 90 m straights and two semicircular ends of radius 28 m ($\pi = \frac{22}{7}$). Find the total perimeter (m) divided by 4.

Digit: ☐

EXIT CODE: ☐ ☐ ☐ ☐ ☐

Formula Sheet

Cut this page out and keep it. Everything in this chapter, on one page.

Perimeter of a square

$$P = 4a$$

Perimeter of a rectangle

$$P = 2(a + b)$$

Circumference of a circle

$$C = 2\pi r = \pi d$$

Arc length

$$ell = 2\pi r \times \frac{\theta°}{360°}$$

Heron's formula

$$s = \frac{1}{2}(a + b + c), Area = \sqrt{s(s-a)(s-b)(s-c)}$$

Brahmagupta's formula (cyclic quadrilateral)

$$s = \frac{1}{2}(a + b + c + d), Area = \sqrt{(s-a)(s-b)(s-c)(s-d)}$$

Area of a circle

$$A = \pi r^2$$

Area of a rhombus

$$A = \frac{1}{2} d_1 d_2$$

Area of a trapezium

$$A = \frac{1}{2}(a + b) h$$

Full Solutions

Not just answers — working. Compare your method with this one; if they differ but both reach the right answer, make sure you understand why yours also works.

Part 3 · Guided Practice

1. s = 15; s-a=6, s-b=5, s-c=4; Area = √1800 = 30√2 ≈ 42.43 sq. cm · **2.** Circumference = 132 m; Area = 1386 sq. m · **3.** b = 5; Area = 5√(169-25) = 5√144 = 5×12 = 60 sq. cm · **4.** Arc length = 2 × 22/7 × 21 × 60/360 = 132 × 1/6 = 22 cm

Practice Set A

1. $P = 4 \times 15 = 60$ cm.

2. $P = 2(12+7) = 38$ cm.

3. $C = 2 \times \frac{22}{7} \times 14 = 88$ cm.

4. Area ¿ $\frac{\sqrt{3}}{4}$ ¿ sq. cm.

5. $s = 8$; Area ¿ $\sqrt{8 \times 3 \times 3 \times 2} = \sqrt{144} = 12$ sq. cm.

6. Area ¿ $40 \times 25 = 1000$ sq. m.

7. Area ¿ $\frac{22}{7} \times 7^2 = 154$ sq. cm.

8. Area ¿ $\frac{1}{2}(10 \times 12) = 60$ sq. cm.

9. Area ¿ $9 \times 6 = 54$ sq. cm.

10. $s = 28$; Area ¿ $\sqrt{28 \times 21 \times 4 \times 3} = \sqrt{7056} = 84$ sq. cm.

Practice Set B

1. $s = 66$; Area ¿ $\sqrt{66 \times 55 \times 6 \times 5} = \sqrt{108900} = 330$ sq. cm.

2. $P = 2(80+60) = 280$ m; Cost ¿ $280 \times 20 =$ ₹5600.

3. Arc length ¿ $2 \times \frac{22}{7} \times 14 \times \frac{90}{360} = 88 \times \frac{1}{4} = 22$ cm.

4. Side ¿ $\frac{60}{3} = 20$ cm; Area ¿ $\frac{\sqrt{3}}{4}$ ¿ sq. cm.

5. Area ¿ $\frac{1}{2}(15+9)(8) = \frac{1}{2}(24)(8) = 96$ sq. cm.

6. $s = 10$ (using $a = b = c = d = 5$); Area ¿ $\sqrt{5 \times 5 \times 5 \times 5} = 25$ sq. cm, matching $5^2 = 25$.

7. Each circle passes through the other's centre, so triangle formed by the two centres and an intersection point is equilateral with side r; each arc subtends 240° at its own centre (reflex outside the lens), giving total perimeter $¿ 2 \times (2\pi r \times \frac{240}{360}) = \frac{8\pi r}{3}$.

8. $s = 60$; Area $¿ \sqrt{60 \times 30 \times 20 \times 10} = \sqrt{360000} = 600$ sq. m; Cost $¿ 600 \times 5 = ₹3000$.

Practice Set C

1. Perimeter 32, base x, equal side $¿ \frac{x}{2} + 9$. Since

$2(\frac{x}{2} + 9) + x = 32 \Rightarrow 2x + 18 = 32 \Rightarrow x = 7$; equal sides $¿ 12.5$. $s = 16$; Area $¿ \sqrt{16 \times 3.5 \times 3.5 \times 9} = \sqrt{1764} = 42$ sq. units.

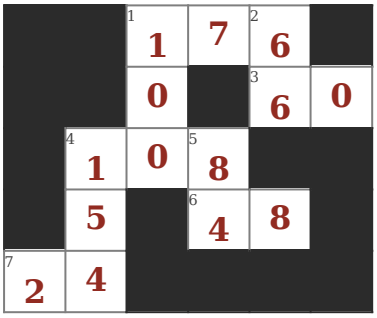
2. Two semicircles of radius 35 m form one circle: $C = 2 \times \frac{22}{7} \times 35 = 220$ m. Total $¿ 2(100) + 220 = 420$ m — this is a 420 m track, 20 m longer than a standard 400 m track.

3. $s = \frac{3a}{2}$; $s - a = \frac{a}{2}$ (three times). Area $¿ \sqrt{\frac{3a}{2} \cdot ¿¿}$, as required.

4. $s = 24$; Area $¿ \sqrt{(24-9)(24-12)(24-13)(24-14)} = \sqrt{15 \times 12 \times 11 \times 10} = \sqrt{19800} \approx 140.7$ sq. cm.

5. Circumference $C = 2\pi r$ is linear in r, so doubling r doubles C. Area $A = \pi r^2$ is quadratic in r, so doubling r multiplies A by $2^2 = 4$.

Part 7 · Crossnumber — Solved Grid



Across: 1 = 176 · 3 = 60 · 4 = 108 · 6 = 48 · 7 = 24
Down: 1 = 100 · 2 = 66 · 4 = 154 · 5 = 84

Part 8 · Number Search — Solved Grid

1	3	6	4	6	1	7	0	**2**	**4**	2	7	2
1	0	2	4	0	**1**	**5**	**4**	8	**8**	4	2	6

0	3	9	0	7	0	8	8	**4**	5	5	7	7
3	9	**1**	**7**	**6**	5	8	9	8	**6**	3	3	**0**
6	6	9	**8**	5	**2**	3	8	2	**5**	9	**6**	5
5	2	9	**4**	3	**1**	0	7	0	1	0	9	2
5	6	3	7	6	1	5	6	2	5	4	1	8
3	2	9	4	7	5	6	1	0	9	2	0	0
9	3	8	5	6	3	1	6	5	3	2	3	9
1	7	0	7	**6**	**6**	0	0	7	4	0	8	1
2	**0**	5	1	1	8	3	5	1	4	9	2	3
8	1	**0**	1	2	**8**	**0**	**1**	0	0	3	5	5
8	5	2	9	0	9	5	0	0	8	**2**	**3**	**1**

Part 8 · Magic Square — Solved (constant 15)

8	**1**	**6**
3	**5**	**7**
4	**9**	**2**

Part 9 · Spot the Mistake

Problem	First wrong step	It should say
Finding the area of a triangle with sides 9, 10, 11 by Heron's formula	Step None	The semi-perimeter is **half** the perimeter: $s=\frac{9+10+11}{2}=15$, not 30. Then $s-a=6, s-b=5, s-c=4$, and Area ¿$\sqrt{15\times6\times5\times4}=\sqrt{1800}=30\sqrt{2}\approx42.4$ sq. units.
Finding the circumference of a circle of radius 10.5 cm using π = 22/7	Step None	Circumference uses $C=2\pi r$, **not** πr^2 (that is area). Correct working: $C=2\times\frac{22}{7}\times10.5=66$ cm.

Problem	First wrong step	It should say
Comparing π with $\frac{22}{7}$	Step 1	The middle statement is the error: $\pi \approx \frac{22}{7}$ is an **approximation**, never an equality — π is irrational and cannot equal any ratio of integers.

Part 10 · Matching

#	Left	Correct match
1	Square, side a	a^2
2	Rectangle, sides a, b	ab
3	Triangle, base b, height h	$\frac{1}{2}bh$
4	Circle, radius r	πr^2
5	Rhombus, diagonals d_1, d_2	$\frac{1}{2}d_1 d_2$
6	Trapezium, parallel sides a, b, height h	$\frac{1}{2}(a+b)h$
7	Triangle, sides a, b, c	$\sqrt{s(s-a)(s-b)(s-c)}$
8	Cyclic quadrilateral, sides a, b, c, d	$\sqrt{(s-a)(s-b)(s-c)(s-d)}$

Part 10 · True or False

1-T · 2-F · 3-F · 4-F · 5-F · 6-T · 7-T · 8-T · 9-F · 10-T · 11-F · 12-T

Part 10 · Two Truths and a Lie

Set	The lie	Correction
1	b	Heron's formula works for **any** triangle, right-angled or not — that is its whole point.
2	c	π can never be written exactly as a terminating or fraction value — 3.14 and 22/7 are both approximations only.

Set	The lie	Correction
3	c	The rhombus area formula is $\frac{1}{2} d_1 d_2$ (product, not sum, of the diagonals, halved).

Part 11 · The Escape Challenge

EXIT CODE: 6 · 44 · 24 · 15 · 89

(Answer: 6) (Answer: 44) (Answer: 24) (Answer: 15) (Answer: 89)

From a relay-race stagger to a farmer's field, perimeter tells you how far around and area tells you how much space is enclosed — and now you can find both, for any triangle or quadrilateral, from the side lengths alone. □□